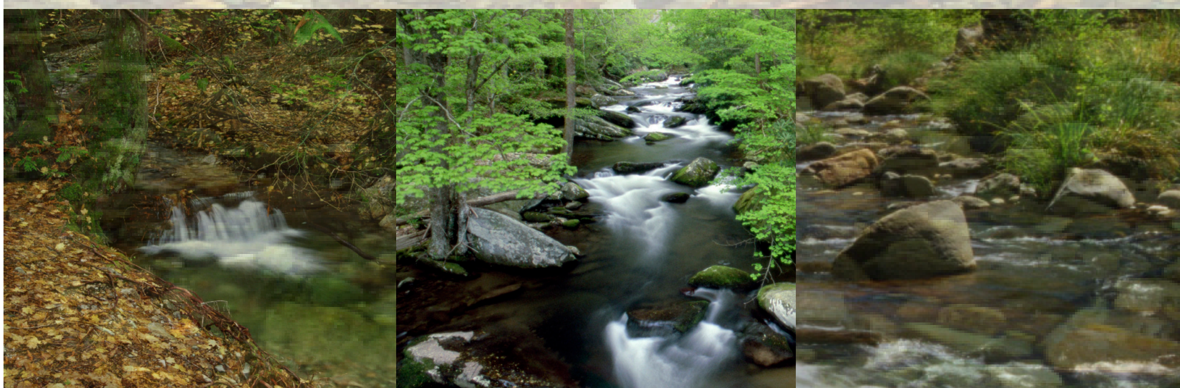
Version 2

City of Rockville



Save Our Streams (SOS)

Monitoring Procedures Manual

Sustainable ROCKVILLE

Introduction

This manual describes the procedures for completing the Rockville Save Our Streams (SOS) citizen stream monitoring program and complements three training classes that volunteers need to attend. This is the **second version of the manual (printed 01/10)** The Rockville SOS program is designed to assess wadeable streams, or streams that are no deeper than waist deep (except pools). Most of the stream segments monitored are at depths between the thigh and the waist or shallower. This document is divided into four sections: water quality analysis; physical characterizations and habitat assessment; inventory of non-native invasive (NNI) plant species, and the bioassessment of the benthic macroinvertebrate community.

The Rockville SOS procedures manual is largely based on the West Virginia (WV) Save Our Streams (SOS) program. Therefore, for more information about general hydrologic and ecological concepts described in these procedures, visit the Volunteer Monitoring Manual section of the WV Save Our Streams website (http://www.dep.wv.gov/WWE/givehelp/sos/Pages/default.aspx). Please note: the WV SOS program is more detailed than the Rockville program. Because of this, volunteers may see some differences in the two programs.

Prior to your site visit you should prepare for your survey by completing the following activities:

- Make sure you have all the necessary monitoring equipment. The City of Rockville will provide monitoring groups with a Volunteer Kit. Volunteer monitors should pick up this kit a week in advance and double check to make sure that equipment is in working condition. Equipment check activities include: checking batteries in electronic equipment and making sure all nets are secured to their poles and have no tears or holes. For a complete list of equipment see Appendix C
- Acquire all proper protective clothing. Volunteers are responsible for their own protective clothing. At the site always wear the correct footwear (waders, boots, closed toed shoes) and clothes for working in and around the stream. If it is cold out, wear layered clothing.
- Review the Rockville SOS Safety Plan found in Appendix A
- Ensure that you are familiar with your monitoring location including parking location access points and reach boundary markers.
- Coordinate with your monitoring team members so all of you have the proper date and time for the visit. We also advise you to have an idea about “who is doing what” (like habitat assessment or NNI inventory) before you head out to the stream.

The city of Rockville seeks to gather quantitative, qualitative and support data from the SOS activities conducted by volunteers. The quantitative data (benthic macroinvertebrate assemblage and several habitat condition and water chemistry parameters) will be used to form a “report card” to describe the health of the City’s streams. The qualitative data, several parameters from the physical and habitat conditions portion of the monitoring, may help explain the trends in the quantitative data. And lastly, the support data (presence of outfalls and their condition, trash and presence of invasive plants) will help City staff to identify stream sections that may be candidates for invasive pulls, trash clean-ups and further investigation of illegal dumping.

The remainder of this manual provides background on and step-by-step procedures for on-site stream survey procedures.

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Reach Delineation

The City of Rockville has pre-selected monitoring sites that will best reflect the health of the City's watersheds. Each monitoring site's borders are indicated with rebar bank pins. City staff can accompany volunteers to the stream location on the first few visits to ensure volunteer monitors properly identify the entire monitoring site. The length and location of the site will stay the same year after year. To the greatest extent possible, the site will have at least one or more of the following channel features:

Riffles have shallow, fast moving water broken on the surface by the presence of coarse substrate such as stacked gravel, cobble and boulders. This feature is the best place from which to collect benthic macro-invertebrates.

Runs are deeper than a riffle with a fast-to-moderate current and usually no breaks in the surface. The substrate is variable but is mostly coarser materials.

Pools have deep, slow moving water. The channel shape is generally bowl-like and often some of the bottom substrates consist of finer sediments such as sand and silt.

How often should you monitor your stations?
Your site should be monitored two times a year, once during the months of March or April and once in October.

Water Chemistry

This section describes Rockville SOS procedures and considerations for conducting water quality analysis aspects of stream monitoring. Volunteers measure conductivity, total dissolved solids, salinity, pH, and temperature using electronic probes. Dissolved oxygen is measured using CHEMets® ampoules. In the future, volunteers will collect water samples to be sent to a laboratory that will test for the presence of nitrate, nitrite, phosphate, and fecal coliform. For information on each parameter and why they are important in a water quality analysis, please refer to Chapter 5 of EPA's Volunteer Monitoring: A Methods Manual (http://www.epa.gov/owow/monitoring/volunteer/stream).

Where do I collect my samples?
Whether using the probe or collecting water for the lab, water samples should be collected from the most representative portion of the reach, which is usually the run, and as close to the downstream end as possible. If the most downstream end of the reach is a riffle or pool, walk upstream until you encounter a run. Collect the water sample in the deepest section of the run. This may not be the center of the channel depending upon physical features or the curvature of the channel. For example, a curved (meandering) channel is usually deepest on the outside bend. When wading to your sample location, be careful not to disturb the bottom sediments (or at least keep the disturbance to a minimum).

How do I collect data using electronic probes?
As outlined above, the data should be collected from the most representative portion of the reach. We will be using a Tracer Pocketester electronic probe to measure pH, conductivity, total dissolved solids (TDS), and salinity. We will use CHEMets ampoules to test dissolved oxygen. Please refer to the volunteer binder for step-by-step instructions on using the probes. All electrodes will be pre-calibrated by City staff prior to use. Please note that the probes are not waterproof and should be submerged only up to the bottom edge of the electrode collar.

Physical Characterization

In this section we discuss general physical observations. These observations should be completed prior to the water quality analysis. Observations focus on water clarity, color and odor; streambed condition; algal growth; surface foam and stream flow.

Table 1 provides a list of the conditions that are assessed as well as some general guidelines regarding what certain characteristics indicate. Water observations are made in runs or riffles, sediment observations are also made in runs or riffles and benthic algae observations are made in a riffle. These observations should be made multiple times throughout the reach to make sure conditions are consistent. You should write comments on the survey data sheet (Appendix D) if any notable differences within the reach are observed.

Table 1- Stream Physical Conditions Characteristics

	Color	**Odors**	**Abundance**	**Growth Habit**
Water Color	**Brown**: Usually caused by sediment in the water. Some muddiness (brown color) is natural after storms, but if the condition persists look for an activity upstream that has disturbed the soil such as construction sites or storm water runoff from roads. **Black**: May be caused by waste material from road construction. **Green**: Usually due to an algae bloom caused by excessive nutrients in the water. The source could be sewage or fertilizers from homes or golf courses. **Multi-colored sheen**: Can occur naturally in stagnant waters, but a sheen that is moving or does not break up easily may be an indication of oil pollution. The source could be runoff from streets or parking areas or illegal dumping. **White** or **gray**: Can be caused by runoff from landfills, dumps or sewage	**Rotten eggs**: This strong sulfur-like odor can be an indication of sewage pollution. **Musky**: This slight organic odor is often natural, but in some cases may indicate nutrient enrichment from organic waste products or sewage contamination. **Oily**: This odor may indicate pollution of oil and gas. **Chemical**: There are a wide variety of chemical odors usually the result of industrial discharges, solvents and detergents. **Sewage**	**NA**	**NA**
Streambed Conditions	**Brown**: An indication of silt deposits from sediment sources. Most stream bottoms are normally brown in color. **Green**: Possible indication of excessive algae growth from organic (nutrient) enrichment sources. **White** or **gray**: A white cottony mass is a sewage fungus common to organic polluted waters.	NA	**NA**	**NA**

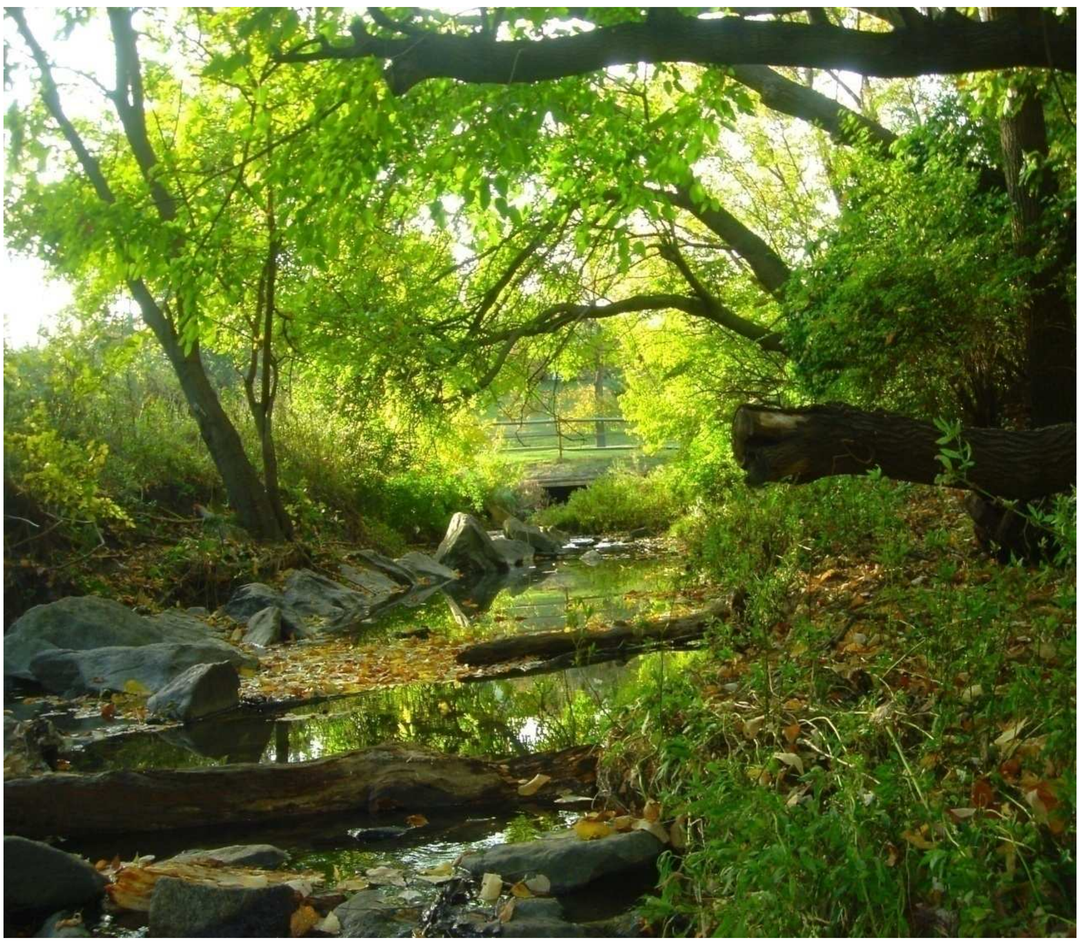
Algae Conditions	Algae color varies from brown to dark green in most streams and rivers; although color is a noticeable condition of the algae it is not a particular indicator of the types or of the condition represented by the algal community.	**NA**	Coverage in a riffle is estimated based upon the following: none, scattered, moderate or heavy. A heavy coating of matted and floating algae is often an indication of nutrient rich conditions caused by excess nitrogen and phosphorous.	Most stream algae will be evenly coated on the rocks and have a smooth or slimy texture; other types will be filamentous and have a hairy texture; and others will be matted. Matted algae are easily removed from the surfaces by slowly scraping with your fingers.

Surface foam may occur naturally due to the decomposition of leaves (this foam is generally less than three inches high and cream colored). Excessive white foam may be due to detergent pollution.

Habitat Assessment

The Rockville SOS Program provides overview training on habitat assessment, which includes information on near stream and in-stream habitat conditions. The purpose of the training is to get volunteers familiar with the terms and give them a practical reference for when they are monitoring.

Healthy Stream



The habitat assessment process involves rating many different **habitat conditions** as optimal, suboptimal, marginal or poor based upon criteria. See Appendix D for Habitat Conditions Field Data Collection Sheet, which includes short descriptions and a rating scale. The optimal category is a description of conditions that meet natural expectations; suboptimal includes descriptions of criteria that are less than desirable, but satisfies expectations under most circumstances; marginal is a description of moderate levels of degradation with severity at frequent intervals throughout the reach; and poor are descriptions of criteria for streams that have been substantially altered with severe degradation characteristics.

Embeddedness refers to the extent to which rocks (gravel, cobble, and boulders) are surrounded by, covered, or sunken into the silt, sand, or mud of the stream bottom. Generally, as rocks become embedded, fewer living spaces are available to macroinvertebrates and fish for shelter, spawning and egg incubation. To estimate the percent of embeddedness, observe the amount of silt and sand sediments overlying and surrounding the larger gavel and cobble size particles. The images on the survey data sheet are provided for guidance purposes only. You should base your embeddedness assessment on the composition of the materials that you observe. Embeddedness is always evaluated in the riffles used for your macroinvertebrate collections. In most cases the best person(s) to comment about this condition is the person(s) collecting macroinvertebrates. If cobble and gravel are easy to remove from the riffle and there is little sand or silt either in the net or suspended during collections, embeddedness is minimal. In some cases chemicals can cement (armoring) the substrate together and cause severe embeddedness.

Sediment deposition is an estimate of the amount of sediment that has accumulated and the changes that have occurred to the stream channel as a result of deposition. Deposition occurs from large-scale movement of sediment. Sediment deposition may cause the formation of islands, point bars (areas of increased deposition usually at the beginning of a meander that increase in size as the channel is diverted toward the outer bank) or shoals, or result in the filling of runs and pools. Usually deposition is evident in areas that are obstructed by natural or manmade debris and areas where the stream flow decreases, such as bends. High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many organisms. Sediment deposition should be rated throughout your reach and should not be confused with embeddedness. Sediment deposition is probably the most difficult condition to assess. It is a natural process and bars often form in streams that are very stable and have little sediment from the surrounding land or few problems with erosion. When assessing this condition look for indicators that are unusual or beyond what is expected to be normal for the stream. The most effective way to learn is to view many different stream types representing both degraded and natural conditions. In most cases island formation, especially in small streams is an indication of excessive deposition. The most common cause for unusual or un-natural deposition in most streams is human encroachment (i.e., structures such as bridges, roads, culverts etc. too close to the stream or built so that the stream is narrowed) and bank erosion. Steep sloping banks with exposed surfaces are more likely to erode. Undercut banks often can erode but are sometimes very stable if covered with vegetation, tree roots and rocks. Look for deposition around eroding banks, especially if

they show bare soils consisting mostly of fine materials (fine gravel, sand and silt). Hard surfaces no matter how steep or undercut are less likely to erode.

The **bank stability** parameter evaluates whether the stream banks are eroded (or have the potential for erosion). Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks, and are therefore considered to be unstable. Signs of erosion include crumbling, un-vegetated banks, exposed tree roots, and exposed soil. Eroded banks indicate a problem of sediment movement and deposition, and suggest a scarcity of cover and organic input to streams.


Example of Bank Erosion

Riparian buffer width is an estimate of the width of natural vegetation from the edge of the stream bank out through the riparian zone. The vegetative zone serves as a buffer to pollutants entering a stream from runoff, controls erosion, and provides habitat. A relatively undisturbed riparian zone supports a robust stream system; narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. Residential developments, urban centers, golf courses, and rangeland are the common causes of anthropogenic degradation of the riparian zone. Conversely, the presence of old fields, paths, and walkways in an otherwise undisturbed riparian zone may be judged to be inconsequential to altering the riparian zone and may be given relatively high scores. Each bank is evaluated separately for this parameter. Riparian buffers are the most valuable protection a stream system has against outside influences. Enhancement of the riparian buffer by re-planting native grasses, forbs, shrubs and trees is the first step in the recovery of the stream back to a more natural condition.

Below are just a few of the benefits of a healthy riparian buffer.

- Provides organic material as food for invertebrate, fish and wildlife.
- Supplies large and small pieces of woody debris that provide habitat for fish, invertebrates and amphibians.
- Alters how sunlight reaches the stream and is an important temperature moderator.
- Stabilizes stream banks and reduces erosion.
- Filters sediment and materials from overland runoff and roots of many plants trap and hold the sediments.
- Absorbs nutrients from overland and sub-surface flows.
- Reduces the impacts of flooding through temporary storage, interception/diversion and slow releases (especially wetlands) from heavy rains.

The **percent shade cover** parameter estimates the amount of shaded area over the stream. Shade cover is important because it keeps the stream protected from temperature changes due to excess sun exposure. Too much sun will raise the stream temperature. Higher temperatures lead to less dissolved oxygen in the water, which is needed to support aquatic life.

Outfalls

The City has an extensive storm drain system, which is designed to carry run-off during precipitation events from houses, streets, parking lots, etc., to streams. This water flows, untreated, directly to our streams. Therefore, pollutants that enter the storm drain system such as garbage; pet waste, fertilizers and auto fluids will contaminate City streams.

Outfalls are made of many materials and come in all different shapes and sizes. They can range from a concrete pipe entering directly into a stream or, more simply, an earthen channel leading to the stream. Picture examples of different outfall types are included in the monitors' binder.

Inventorying storm drain outfalls, the point where the storm drain system meets the stream, and monitoring them over time is key to finding and eliminating pollution sources. Environmental management Division (EMD staff) conduct such inventories, but volunteer monitors can help by informing EMD staff of any outfalls that appear to be in disrepair or show evidence of contaminated flow. Storm drains are designed to carry run-off from precipitation events. It can take up to 48 hours after a storm for the run-off to enter the stream. Any other flow is considered to be a "dry weather flow" and should be investigated for contamination. Evidence of contamination might include staining, odor, water discoloration, oil sheens, soapsuds and floatables like toilet paper or abnormal (markedly different than the surrounding stream area) vegetation or algal growth. Please refer to the field equipment for pictures of pollution indicators.

Photo Documentation

Photographs provide a qualitative and potentially semi-quantitative record of conditions in a watershed, or within a stream reach. Photographs can be used to document general conditions, pollution events or other impacts, and document temporal progress for restoration efforts or other projects designed to benefit water quality. Take photo from the same position (photo point), every time you monitor. Take into consideration bearing and vertical angle. Take at least two photos that show the entire reach. More specific photos can be taken if needed. It is often important to include a ruler or person to convey the scale of the image. The City does not provide a camera. We ask that volunteers take digital photos and email them to environment@rockvillemd.gov. The subject line should say Rockville SOS photo and include the monitoring site name.

Non-Native Invasive (NNI) Plant Inventory

Non-native invasive plants have the ability to thrive and spread aggressively outside of their natural geographic range. An invasive plant species that colonizes a new area may gain an ecological edge since the insects, diseases and foraging animals that naturally keep its growth in check in its native range not present in its new habitat. NNIs pose a threat to our natural resources because they rapidly invade new areas, they produce significant changes in ecosystem compositions, they alter ecosystem processes and they replace native food sources on which wildlife depends.

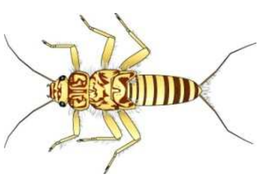
The best defense against nonnative plant takeovers is constant surveillance followed by effective control measures at the first appearance of new arrivals. Early detection will help to monitor the level of invasion and will allow for early treatment.

There are 17 NNIs that are considered to be the most problematic species in our area. The 17 are listed below and their pictures are included in your field equipment. Measure approximately 50-100 feet from the stream and define your buffer observation area. Take field notes, photographs and make sketches of any invasive species you observe within your buffer observation area. Approximate the number of NNIs present by estimating the number of NNI plants per square foot.

Table 3 17 Target NNIs

Vines	Trees	Shrubs	Herbs
Porcelainberry (PB) (*Ampelopsis brevipedunculata*)	Tree-of-heaven (TH) (*Ailanthus altissima*)	Autumn olive (AO) (*Elaeagnus umbellata*)	Garlic mustard (GM) (*Alliaria petiolata*)
Oriental bittersweet (OB) (*Celastrus orbiculatus*)		Exotic bush honeysuckle (EBH) (*Lonicera spp.*)	Canada thistle (CT) (*Cirsium arvense*)
Wintercreeper (WC) (*Euonymus fortunei*)		Multiflora rose (MR) (*Rosa multiflora*)	Japanese stilt grass (JSG) (*Microstegium viminuem*)
English ivy (EI) (*Hedera helix*)		Wineberry (WB) (*Rubus phoenicolasius*)	Japanese knotweed (JK) (*Polygonum cuspidatun*)
Japanese honeysuckle (JH) (*Lonicera japonica*)			Lesser celandine (LC) (*Ranuculus ficaria*)
Devil's thumb/Mile-a-minute (DT) (*Polygonum perfoliatum*)			
Kudzu (KU) (*Pueraria montana var. lobata*)			

Macroinvertebrate Collection, Sorting and Identifying



The Rockville SOS Program provides overview training on benthic macroinvertebrate collection, sorting and assessment. This training will prepare volunteers to collect and identify macroinvertebrates to the order level (we will learn identification to some family levels as well).

The groups of animals found in leaf packs, rocks, woody debris and other areas of streams, rivers, ponds and wetlands are collectively called benthic macroinvertebrates (also called aquatic invertebrates). Benthic refers to the ability to cling to bottom surfaces such as rocks, leaves or roots. Macroinvertebrates are animals without a backbone that can be seen with the naked eye. These bottom-dwelling animals include crustaceans, mollusks, annelids, and larvae and nymph forms of aquatic insects. Macroinvertebrates are an important link in the food web between the producers (leaves, algae) and higher consumers such as fish. They are the key indicators of biological integrity in a wide variety of aquatic environments.

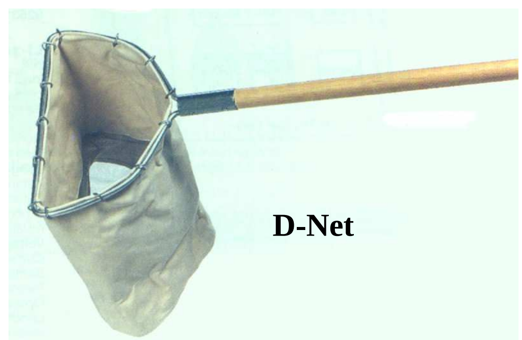
Collecting

Benthic macroinvertebrates live in a wide variety of aquatic environments. In streams and swift-flowing rivers they are most common in rocky areas, especially riffles, but are also found in runs which are sampled when riffles are not present. The collection procedures described here are designed for rock-bottom streams from riffle habitats.

1. **Choose the best habitats**: Your goal is to collect a representative sample of macroinvertebrates from your entire reach using 20 net grabs. Be sure to select your net grabs in proportion to the habitat types in your overall reach (i.e. a reach with habitats including 20% root wads, 30 % undercut banks, and 50 % riffles would require 4 net grabs from the root wads, 6 from the undercut banks, and 10 from the riffles). Riffles should have different characteristics (i.e. different composition, but mostly cobble and gravel and should include different velocities) as different types hold different varieties of macroinvertebrates. Remember to always approach from the downstream end, sampling the site farthest downstream first to reduce the chances of biasing your remaining sample area.

2. **Get into position**: Have the stream collection tub ready before you begin collecting the sample. For riffles, select an area approximately the same width (or slightly less) than the width of your D-net. The net holder will place the net snugly against the bottom of the streambed.

3. **Begin disturbing the streambed**: The second person should estimate 1 foot directly in front of the D-net as their "target disturbance area" and disturb the area first by rock rubbing. Pick-up all large rocks and inspect them. You are looking for snails, clams and caddisfly cases. These animals often cling very tightly to the rocks and are not removed by just a simple rub with the hands or a small brush. If the rocks have any of these animals, remove them from the rocks and place them inside the stream collection tub. Move the rocks you picked-up slightly into the net; brush all sides of the rocks with your hands or a small vegetable-brush to dislodge other clinging macroinvertebrates. If the rocks cannot be lifted from the streambed, simply rub them where they lay. After the rocks are rubbed they should be placed aside (outside of the sample area) so they are not rubbed a second time.

   After you are satisfied that all or most of the larger rocks have been cleaned you will disturb the remainder of the streambed using a kicking method. Position yourself in front of the net and begin shuffling one foot back and forth approximately 1 square foot in front of the net. The action dislodges macroinvertebrates from smaller size gravel and also disturbs those macroinvertebrates that might be burrow themselves down into the soft bottom sediments. Adequate rock rubbing and kicking should last from two to four minutes (or less) depending upon the abundance of cobbles and boulders within your sample area.

   To sample ***vegetated bank margins***, jab vigorously with an upward motion, brushing the net against vegetation and roots along the bank. The entire jab motion should occur underwater. To sample ***snags* and *logs*,** hold the net with one hand under the section of submerged wood you are sampling. With the other hand (which should be gloved), rub about 1 square foot of area on the snag or log. Scoop organisms, bark, twigs, or other organic matter you dislodge into your net. Each combination of log rubbing and net scooping is one jab. To sample ***aquatic vegetation beds***, jab vigorously, with an upward motion, against or through the plant bed. The entire jab motion should occur underwater.

4. **Remove the D-net from the streambed and capture the collection**: This is a very important step; since the sample collection is laborious you do not want to lose any of the macroinvertebrates collected by sloppy transfer procedures. You may need to empty the D-net before completing all 20 grabs. A stream collection tub should be at the ready to accept the contents of the D-net.

5. **Place the net over the tub**: Before attempting to transfer macroinvertebrates to the stream collection tub, use a small tub (butter tub) to rinse the D-net a few times into the stream to remove large amounts of sediment. This will help reduce the need to rinse the net so many times that the collection tub fills too rapidly with stream water. With a small tub (butter tub), wash the contents of the D-net into the bucket. It will take several minutes and several washes to knock loose most of the macroinvertebrates. After several rinses with the net “right-side-in”, remove the net and check for macroinvertebrates that have not been dislodged. Often these hardy clingers are found near the edges of the D-net along the seams of the net. Be sure to check the opposite side for macroinvertebrates that may have crawled in an attempt to escape. Turn the net inside out for a few last rinses. You must be very careful not to overfill the bucket. If the bucket begins to fill with stream water more than about two-thirds its height, remove some of the water by seining it through the D-net over an additional stream collection tub so that the water is poured off and the macroinvertebrates remain in the D-net. Be sure to reserve this water and place any escape macroinvertebrates into the stream collection tub that will eventually hold all net grabs and rinses. The process is complete when you are satisfied that the D-net has been thoroughly washed and most of the macroinvertebrates are now in 1 stream collection tub.

6. **Remove the captured macroinvertebrates from the bucket and begin sorting and identifying**.

Sorting and Identifying

You may find salamanders and fish in your stream collection tub. Although these are not identified or counted, feel free to note their presence on the Macroinvertebrate Tally Sheet **(Appendix F)**. Please return them to the water as soon as possible.

Remove all leaf packs and root wads from the stream collection tub after careful examination for macros. Remove any visible macroinvertebrates from these materials and place them back into the stream collection tub in order to avoid habitat bias. Place the leaf packs and root wads into a separate butter tub with reserved stream water and check them periodically for macros that might be hiding. (If you discover additional macros in the reserve tub as the monitoring session progresses, place them in the stream collection tub so that the probability of selecting them later is the same as though they had never been removed from the stream collection tub.)

Sorting macroinvertebrates from survey samples (a procedure often referred to as "bug picking") is an extremely important step in the stream monitoring process. The quality of the work and the monitors’ ability to identify the invertebrates influences the quality of data analysis and reporting. The outcome of the final report may be affected, even if only a few organisms are overlooked or misidentified during the picking process.

Begin sorting macroinvertebrates, attempting to pick several small, then medium, then large specimens. Continue to pick varying sizes in order to avoid size bias. Place a picked macroinvertebrates under the scope for identification and then place them into one of the sections of an ice cube tray. Continue to place macroinvertebrates into the sections of the ice cube tray according to their order. You may need several sections for one order. At the bottom of the Macroinvertebrate Tally Sheet, keep a hatch mark tally of the TOTAL number of macros you have picked from the stream collection bucket. You will sort and count individual orders in the next step.

Once you have sorted all macros into ice cube trays (having reached 100 hatch marks or emptied the stream collection bucket of all visible macroinvertebrates), begin to enter the number of each order (or Common netspinner or case builder/non-case builder types in the case of Caddisflies) and the number of kinds of each order onto the proper fields of the Macroinvertebrate Tally Sheet. Upon completion of streamside data entry, remove all macros from the ice cube trays, placing them back into the stream collection tub for release into the stream.

At times identification can be very difficult in the field so your group may need to preserve some specimens that give you a particularly hard time. Vials containing a mixture of Isopropyl alcohol and glycerin for preserving unknowns are provided as part of your monitoring kit. If your group does have difficulty identifying specimens, please group them as best you can in the ice cube trays; preserve one of each of the unknown specimens by placing them in the provided vials. Indicate AT THE TOP of the field data sheet that you have unknowns. Note some identifying feature if you have more than one unknown and place them in separate vials. (i.e. 2-tailed specimen in vial #1 = 5 counted; wormlike specimen in vial #2 = 2 counted). Be sure to mark the date, your name and stream reach identifier on the vials. Turn the preserved specimens into the City of Rockville's Environmental Management Division along with the equipment kit within 5 days of monitoring.

After your group is finished sampling, thoroughly rinse all nets, pans, etc. that have been used for sampling. Examine all equipment carefully and pick free and organisms or debris remaining on nets and in tubs or ice cube trays.

Stream Score and Integrity Rating: Assessment of the Macroinvertebrate Assemblage Sampled

In stream bioassessments, tolerance refers to the degree to which organisms can tolerate environmental degradation. Tolerance Values (TVs) are assigned to individual taxa or groups of taxa that represent their tolerance to pollution. The TVs are then combined into metrics that help describe characteristics of aquatic assemblages sampled.

The City of Rockville has developed its own order level metrics and associated rating system to describe the City's streams. The rating system produces a Stream Score (SS) and an Integrity Rating (IR). The rating system is divided into 4 sub-ranges representing values expected from least stressed or optimal ("reference" sites), suboptimal, marginal, and poor (most stressed) communities. Then, depending on the range into which a specific characteristic at a particular site falls, it is assigned a score of 7, 5, 3, or 1 respectively. The SS is the sum of these character scores, generating a maximal (least stressed) score of 35 and a minimal value (most stressed) of 5. The IR is a qualitative description (i.e. optimal, suboptimal, marginal, and poor) of the SS.
Upon completion of a stream monitoring, a monitor is asked to transfer organism counts from a field data sheet, the Macroinvertebrate Tally Sheet to the Integrity Calculations Excel Worksheet **(Appendix H)**. If no one in the group is comfortable with this step, the Macroinvertebrate Tally sheet may be turned into staff member. Once values are entered, the formulas within the worksheet produce the SS and IR. Further instructions on data entry are provided within the actual spreadsheet.

The tolerance values and point scales associated with the City's SS and IR are calculated from formulas derived from hundreds of stream collections from all across West Virginia. It is assumed that the West Virginia reference streams are similar to those of the non-tidal reference streams in Maryland (specifically Rockville). The metrics used to derive the SS and IR and their predicted response to perturbation are discussed in the following section.

Benthic Metrics Used to Derive Stream Score and Integrity Rating

Taxa richness is the number of distinct taxa (i.e., genera, families, orders, etc.) found in the sample, or more simply stated the total number of families collected. Richness measures reflect the diversity of the aquatic life in a sample. Increasing diversity correlates with increasing health of the sample suggesting that niche space, habitat, and food sources are adequate to support many species.

EPT Taxa richness is the number of 3 pollution sensitive taxa: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (Caddisflies) found in the sample. Increasing numbers of these orders correlates with increasing health of the sample suggesting that niche space, habitat, and food sources are adequate to support these species.

Biotic Index is the total tolerance score (number of organisms per group multiplied by their respective tolerance value) divided by total number of organisms in the sample.

Tolerance/Intolerance measures may be representative of relative sensitivity to perturbation (non-specific to type of stressor) and here includes percent of pollution intolerant and tolerant taxa composition.

- **Percent EPT** is the total number of organisms within the orders Ephemeroptera, Plecoptera and Trichoptera divided by the total number of organisms in the sample.
- **Percent Tolerant** is the total number of organisms with a tolerance of ≥ 7 divided by the total number of organisms in the sample.
  Both results are multiplied by 100 to determine the percentage

Table 4 Predicted Responses to Benthic Metrics as Perturbation Increases

Metric	**Definition**	**Predicted response to Increasing perturbation**
Total No. taxa (richness)	Measures the overall variety of the macroinvertebrate assemblage	Decrease
No. EPT taxa (richness)	Number of taxa in the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (Caddisflies)	Decrease
Biotic Index (Tolerance/Intolerance)	Uses tolerance values to weight abundance in an estimate of overall pollution.	Increase
% EPT (composition)	Percent of the composite of mayfly, stonefly, and caddisfly larvae (intolerant organisms)	Decrease
% tolerant (composition)	Percent of the total number of organisms in the sample with a tolerance of ≥ 7.	Increase

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Illustrations courtesy of the Cacapon Institute (http://www.cacaponinstitute.org/); Jennifer Gillies, artist. Used with permission.

Appendix A - Safety Precautions

In order to participate in the Rockville SOS Program, volunteers will need to sign a volunteer waiver form found in Appendix B. While safety at the site is the responsibility of the volunteer, the City of Rockville highly suggests volunteers follow the guidelines outlined below.

1. **Medical Form**: Have each member of the sampling team complete a medical form that includes emergency contacts, insurance information, and pertinent health information such as allergies, diabetes, epilepsy, etc. Sample Medical form can be found in Appendix C.

2. **Never drink the water in a stream**: Assume it is unsafe to drink, and bring your own water from home. After monitoring, wash your hands with antibacterial soap.

3. **Always monitor with partner**(s): Use a minimum of 2 persons; teams of 4-5 or more people are best; always let someone else know where you are, when you intend to return and what to do if you don't return at the appropriate time.

4. **Be familiar with the first aid kit in the monitoring supply box**: Know any important medical conditions of team members (e.g., heart conditions or allergic reactions to bee stings).

5. **Listen to weather reports**: Never go sampling if severe weather is predicted or if a storm occurs while at the site.

6. **Never wade high water**: Do not monitor if the stream is very swift or at flood stage; adult volunteers should not enter swift-flowing water above waist-deep, unless absolutely necessary, and young volunteers should not enter swift-flowing water above knee-deep.

7. **Park in a safe location**: If you drive, be sure your car doesn't pose a hazard to other drivers and that you don't block traffic.

8. **Put your wallet and keys in a safe place**: Use a watertight bag you keep in a pouch strapped to your waist. Without proper precautions, wallet and keys might join the macroinvertebrates in the stream.

9. **Do not sample on private property:** Stick to the sampling site assigned by the City unless otherwise directed by City contact.

10. **Confirm your location**: Prior to visiting your site(s) check maps, and make sure all volunteers are aware of the location using site descriptions and specific directions.

11. **Know what to do if you get bitten or stung**: Watch for irate dogs, wildlife (particularly snakes), and insects such as ticks, hornets, and wasps.

12. **Watch for vegetation in your area that can cause rashes and irritation**: Learn to identify (in all seasons) poison ivy, poison oak, sumac and other plants that may cause irritation; be aware of briers and thorny plants as well.

13. **Do not monitor if the stream is posted as unsafe:** Do not monitor if the water appears to be severely polluted. No matter what the water conditions are, always remove wet shoes and clothes as soon as possible after leaving the stream; use anti-bacterial soap and shower soon after the stream survey is completed.

14. **Do not walk on unstable stream banks**: Disturbing these banks can accelerate erosion and might prove dangerous if a bank collapses. Disturb streamside vegetation as little as possible.

15. **Be very careful when walking in the stream itself**: Rocky-bottom streams can be very slippery and can contain deep pools; muddy-bottom streams might also prove treacherous in areas where mud, silt, or sand has accumulated. If you must cross the stream, use a walking stick to steady yourself and to probe for deep water or muck. Your partner(s) should wait on dry land ready to assist you if you fall. Do not attempt to cross a stream that is swift.

16. **Come prepared for outside work**: Wear clothes such as a hat, loose fitting clothes (especially during warmer weather), closed-toed shoes such as sneakers, boots or waders. Felt glued to the bottom of the shoe will improve your traction for walking in the stream. The outside conditions should determine your overall manner of dress. You should also have plenty of drinking water, sunscreen and insect repellent.

Appendix B – Volunteer Waiver

SUSTAINABLE ROCKVILLE
VOLUNTEER PROGRAM

LIABILITY RELEASE WAIVER

I understand that my services are being offered on a voluntary basis without anticipation of financial compensation. I authorize the City of Rockville to use my name, likeness, and/or voice in a variety of uses for the purpose of publicizing and promoting City sustainability programs. I shall indemnify and hold harmless the City of Rockville, its employees, agents or volunteers from any and all claims for injuries, damages or loss which I may incur, that may arise out of, or in any way be connected with or associated with my volunteer services.

I have read, fully understand and agree to the above:

Signature of Volunteer: ____Date: ___________________

Printed Name: _________________________

Signature of Parent/Guardian: ____Date:___________________
(If under 18 years of age)

Emergency Contact:____

Allergies:____

Appendix C - Equipment List

The City of Rockville will provide volunteers with the Volunteer Kit. Below is a checklist outlining what the volunteer should bring and what will be included in the kit. Go through this checklist before you visit the site to make sure you have everything you need to be successful. If you find some equipment missing from the kit, contact the Environmental Management Division at 240-314-8870 Monday thru Friday 9-5.

	Volunteer Responsibility
1.	Appropriate clothes and foot wear (i.e., hats, loose-fitting clothes for warm weather, layered clothes for cooler weather; raingear for wet-weather; waders, boots, closed-toed shoes)
2.	Digital Camera
	City-Provided Volunteer Kit
	General
3.	First aid kit
4.	Field binder including all field keys, chemical probe instructions and City contact information
	Aquatic Insect Identification
5.	Collection D-Net
6.	Spoons, Pipettes, Petri dishes
7.	Gloves (non-allergenic latex or rubber)
8.	Stream collection tubs
9.	2 Vials of Preservative (denatured alcohol and glycerin)
10.	Small folding table
11.	Sorting trays 3-4 (white ice cube trays)
12.	2 field scopes
13.	Vegetable brush
14.	Field ID guides
15.	pencil
	Water Quality Analysis
16.	Probe and DO sampling kit and distilled water

Appendix D - Stream Assessment Data Sheet

Stream Description

Stream name: ______________________________ Survey date __________

Watershed name: ______________________________

Survey completed by: Names ______________ Phone #s (to clarify entries) ______________

______________ ______________

______________ ______________

Photo log picture taken: ☐Yes ☐ No If no, why? ______________________________

Date of last rainfall? __________ Amount of precipitation? ______________________ Air temp: __________

Water Chemistry: Use the spaces below to record the results of your water quality analysis; attach additional sheets if necessary.

	Result	units		Result	units		Result	units
Temperature		C/F	Dissolved oxygen		mgL	Alkalinity	x	
pH		-	Transparency		cm	Metals (describe)	x	
Conductivity		µS	Nitrate/Nitrite	x		Fecal/E-coli	x	
TDS		mgL	Phosphate	x		Other (Describe)		
Salinity		PpmS	Optical Brighteners	x				

Additional tests (describe and record results) ______________________________

____

Physical Conditions: Use the check boxes below to describe the conditions that closely resemble those of your stream. The extra lines are provided to write in any additional comments. You may see more than one type of condition; if so, be sure to indicate these on your survey (check all that apply). If multiple conditions are observed, always indicate the most dominant condition.

Note: If the condition you observe is not listed, describe it in the comment section.

Water clarity		Water color		Water odor		Surface foam	
Clear	☐	None	☐	None	☐	None	☐
Murky	☐	Brown	☐	Rotten egg	☐	Slight	☐
Milky	☐	Black	☐	Musky	☐	Moderate	☐
Muddy	☐	Green	☐	Oily	☐	High	☐
Other (describe)	☐	Multi-color sheen	☐	Chemical	☐		
______________		White/Green	☐	Sewage	☐		

Algae color		Algae abundance		Algae Texture		Streambed color	
Light green	☐	None	☐	Even coating	☐	Brown	☐
Dark green	☐	Scattered	☐	Hairy	☐	Black	☐
Brown	☐	Moderate	☐	Matted	☐	Green	☐
Other (describe)	☐	Heavy	☐	Floating	☐	White/gray	☐
						Orange/red	☐

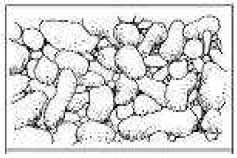
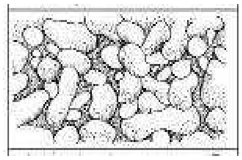
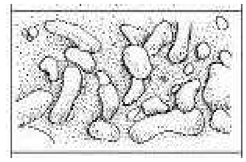
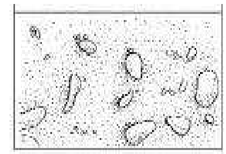
Additional Comments: ______________________________

____

____

Habitat Conditions (Stream Assessment Data Sheet Page 2)

Rate the habitat conditions by circling the best description for the stream

Embeddedness	 Fine sediments surrounds <10% of the spaces between the gravel, cobble and boulders.	 Fine sediment surrounds 10-30% of the spaces between the gravel, cobble and boulders.	 Fine sediment surrounds 30-60% of the spaces between the gravel, cobble and boulders.	 Fine sediment surrounds > 60% of the spaces between the gravel, cobble and boulders.
	Optimal (**O**) = 20 19 18 17 16	Suboptimal (**S**) = 15 14 13 12 11	Marginal (**M**) = 10 9 8 7 6	Poor (**P**) = 5 4 3 2 1

Embeddedness should be evaluated in riffles/runs during your macroinvertebrate collections

Sediment deposition **Ave: _______**	< 5% of the reach has depositional features such as islands, point bars, lateral bars or other indications of deposition. The features consist mostly of boulder, cobble and gravels.	5-30% of the reach has depositional features. The features consist mostly of cobble, gravel and sand.	30-50% of the reach has depositional features. The features consist mostly of gravel, sand and some silt; very little or no cobble found on the bars.	> 50% of the reach has depositional features. The features consist mostly of gravel, sand and silt. There are obvious indications that pools are being filled in.
L | **R**	Optimal (**O**) = 20 19 18 17 16	Suboptimal (**S**) = 15 14 13 12 11	Marginal (**M**) = 10 9 8 7 6	Poor (**P**) = 5 4 3 2 1

Bank stability **Ave: _______**	Banks are stable; no evidence of erosion or bank failure; little or no potential for future problems; < 10% of the reach affected.	Banks are moderately stable; infrequent areas of erosion occur, mostly shown by banks healed over or a few bare spots; 10-30 % of the reach affected.	Banks are moderately unstable; 30-50% of the reach has some areas of erosion; high potential for erosion during flooding events.	Banks are unstable; many have eroded areas (bare soils) along straight sections or bends; obvious bank collapse or failure; > 50% affected.
L | **R**	Optimal (**O**) = 20 19 18 17 16	Suboptimal (**S**) = 15 14 13 12 11	Marginal (**M**) = 10 9 8 7 6	Poor (**P**) = 5 4 3 2 1
Riparian buffer width **Ave: _______**	Mainly undisturbed vegetation > 60 ft; no evidence of human impacts such as parking lots, road beds, clear-cuts, mowed areas, crops, lawns etc.	Zone of undisturbed vegetation 40-60 ft; some areas of disturbance evident.	Zone of undisturbed vegetation 20-40 ft; disturbed areas common throughout the reach.	Zone of undisturbed vegetation < 20 ft; disturbed areas common throughout the entire reach.
L | **R**	Optimal (**O**) = 20 19 18 17 16	Suboptimal (**S**) = 15 14 13 12 11	Marginal (**M**) = 10 9 8 7 6	Poor (**P**) = 5 4 3 2 1
Bank Shading	More than 80 percent of the stream area is shaded by tree canopy.	80-60 percent of the steam area is covered by tree canopy.	60-40 percent of the stream area is covered by tree canopy.	Less than 40 percent of the stream area is covered by tree canopy.
	Optimal (**O**) = 20 19 18 17 16	Suboptimal (**S**) = 15 14 13 12 11	Marginal (**M**) = 10 9 8 7 6	Poor (**P**) = 5 4 3 2 1

Comment on the amount of trash throughout your reach	**None**	**Scattered** *(Circle one)*	**Moderate**
Type of trash	Industrial/commercial (Any trash with name of business)	Residential (bags of household trash/ yard clippings)	Large dump (furniture/tires).
Is this a good candidate for a stream cleanup?			

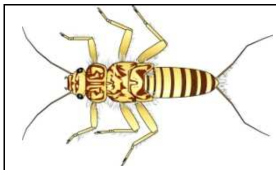
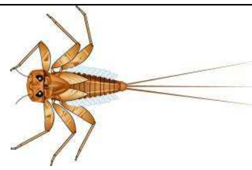
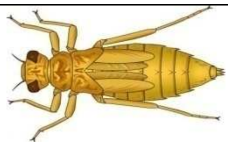
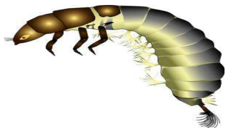
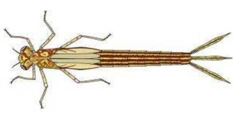
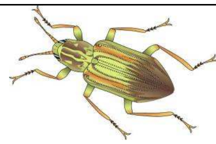
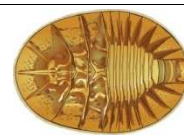
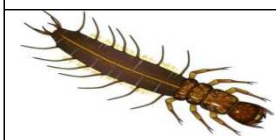
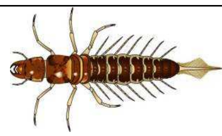
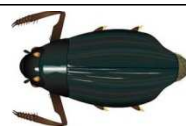
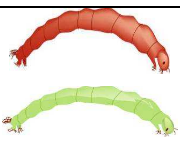
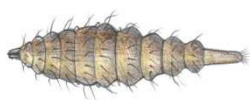
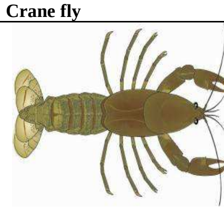
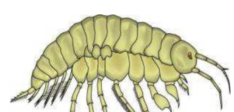
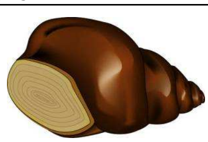
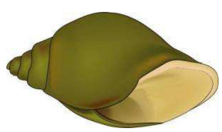
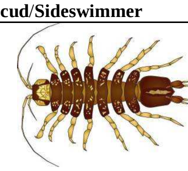
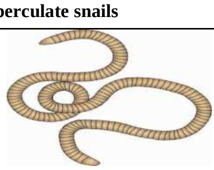
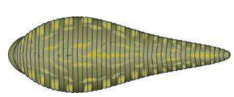
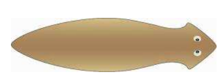
Appendix E – Non-Native Invasive Plant Inventory

Vines	Trees	Shrubs	Herbs
Porcelainberry (*Ampelopsis brevipedunculata*) ❑ None ❑ Scattered ❑ Moderate	Tree-of-heaven (Ailanthus altissima) ❑ None ❑ Scattered ❑ Moderate	Autumn olive (*Elaeagnus umbellata*) ❑ None ❑ Scattered ❑ Moderate	Garlic mustard (*Alliaria petiolata*) ❑ None ❑ Scattered ❑ Moderate
Oriental bittersweet (*Celastrus orbiculatus*) ❑ None ❑ Scattered ❑ Moderate		Exotic bush honeysuckle (*Lonicera spp*.) ❑ None ❑ Scattered ❑ Moderate	Canada thistle (*Cirsium arvense*) ❑ None ❑ Scattered ❑ Moderate
Wintercreeper (*Euonymus fortunei*) ❑ None ❑ Scattered ❑ Moderate		Multiflora rose (*Rosa multiflora*) ❑ None ❑ Scattered ❑ Moderate	Japanese stilt grass (*Microstegium viminuem*) ❑ None ❑ Scattered ❑ Moderate
English ivy (*Hedera helix*) ❑ None ❑ Scattered ❑ Moderate		Wineberry (*Rubus phoenicolasius*) ❑ None ❑ Scattered ❑ Moderate	Japanese knotweed (*Polygonum cuspidatun*) ❑ None ❑ Scattered ❑ Moderate
Japanese honeysuckle (*Lonicera japonica*) ❑ None ❑ Scattered ❑ Moderate			Lesser celandine (*Ranuculus ficaria*) ❑ None ❑ Scattered ❑ Moderate
Devil's thumb/Mile-a-minute (*Polygonum perfoliatum*) ❑ None ❑ Scattered ❑ Moderate			
Kudzu (*Pueraria montana var. lobata*) ❑ None ❑ Scattered ❑ Moderate			

Appendix F – Macroinvertebrates Tally Sheet

As you sort macroinvertebrates keep a hash mark tally of the TOTAL number of macros you have picked from the stream collection bucket at the bottom or on the back of this sheet. You will sort and report individual orders and number of kinds in the next step.
Once you have sorted all macros into ice cube trays (having reached 100 hash marks or emptied the stream collection bucket of all visible macroinvertebrates), enter the number of each order (or family or case builder/non-case builder Caddisfly types) and the number of kinds of each order below.

Illustrations courtesy of the **Cacapon Institute**; Jennifer Gillies, artist

 **Stoneflies**	**# of kinds**	 **Mayflies**	**# of kinds**	 **Caddisflies**	Case-builders **# of kinds**
 **Dragonflies**	**# of kinds**	 **Caddisfly**	Common netspinner	 **Caddisflies**	Net-spinners/Free-living **# of kinds**
 **Damselflies**	**# of kinds**	 **Riffle beetle**		 **Water penny**	
 **Fishfly/Dobsonfly (Hellgrammite)**		 **Alderfly**		 **Other beetles**	**# of kinds**
 **Midges**		 **Black fly**		 **Crane fly**	
 **Watersnipe fly**		 **Other flies**	**# of kinds**	 **Crayfish**	
 **Clams**	**# of kinds**	 **Mussel**		 **Scud/Sideswimmer**	
 **Operculate snails**	**# of kinds**	 **Non-operculate snails**	**# of kinds**	 **Aquatic sowbug**	
 **Aquatic worms**		 **Leech**		 **Flatworms**	

Other aquatic life and invertebrates observed/collected: ____

____